embodiments, the user can provide input additionally or alternatively through voice recognition, where a microphone on the device inputs the user's voice which is translated to appropriate commands or data by software running on the device. Physical buttons **84** can also be included in the housing of the device **80** to provide particular commands to the device **80** when the buttons are pressed. Many PDA's are characterized by the lack of a standard keyboard for character input from the user; rather, an alternative input mode is used, such as using a stylus to draw characters on the screen, voice recognition, etc. However, some PDA's also include a fully-functional keyboard as well as a touch screen, where the keyboard is typically much smaller than a standard-sized keyboard. In yet other embodiments, standard-size laptop computers with standard keyboards may include flat-panel touch-input display screens, and such screens (similar to screen **12** of FIG. **1**) can be provided with haptic feedback.

[**0074**] The touch screen **82** provides haptic feedback to the user similarly to the touchpad **16** described in previous embodiments. One or more actuators **86** can be coupled to the underside of the touch screen **82** to provide haptic feedback such as pulses, vibrations, and textures; for example, an actuator **86** can be positioned near each corner of the screen **82**, as shown in FIG. **8***a*. Other configurations of actuators can also be used. The user can experience the haptic feedback through a finger or a held object such as a stylus **87** that is contacting the screen **82**.

[**0075**] As shown in FIG. **8***b*, the touch screen **82** is preferably coupled to the housing **88** of the device **80** by one or more spring or compliant elements **90**, such as helical springs, leaf springs, flexures, or compliant material (foam, rubber, etc.) The compliant element allows the touch screen **82** to move approximately along the z-axis, thereby providing haptic feedback similarly to the touchpad embodiments described above. Actuators **86** can be piezo-electric actuators, voice coil actuators, or any of the other types of actuators described above for the touchpad embodiments. As shown in FIG. **8***b*, the actuators **86** are directly coupled to the touch screen **82** similarly to the touchpad embodiment of FIG. **3**; alternatively, an inertial mass can be moved to provide inertial feedback in the z-axis of the touch screen, similarly to the touchpad embodiment of FIG. **6**. Other features described above for the touchpad are equally applicable to the touch screen embodiment **80**.

[**0076**] In the embodiments of touch input devices (touchpad and touch screen) described herein, it is also advantageous that contact of the user is detected by the touch input device. Since haptic feedback need only be output when the user is contacting the touch device, this detection allows haptic feedback to be stopped (actuators "turned off") when no objects are contacting the touch input device. This feature can conserve battery power for portable devices. If a local touch device microprocessor (or similar circuitry) is being used in the computer, such a microprocessor can turn off actuator output when no user contact is sensed, thus alleviating the host processor of additional computational burden.

[**0077**] While the subject matter has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many different types of actuators can be used to output tactile sensations to the user. Furthermore, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to be limiting.

What is claimed is:

1. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device.

2. The haptic feedback device of claim 1, wherein the computer device is a portable computer.

3. The haptic feedback device of claim 2, wherein the portable computer is chosen from the group consisting of a PDA, a pager and a cellular phone.

4. The haptic feedback device of claim 1, wherein the touch screen is provided in a housing that is separate from the computer device.

5. The haptic feedback device of claim 1, wherein the touch screen is operative to receive a location selection from a user's finger.

6. The haptic feedback device of claim 1, wherein the touch screen is operative to receive a location selection from a physical object held by the user.

7. The haptic feedback device of claim 6, wherein the physical object is a stylus.

8. The haptic feedback device of claim 1, wherein the touch screen is integrated in a housing of a handheld device that is capable of operation by at least one hand of the user.

9. The haptic feedback device of claim 8, wherein the handheld device is a remote control device for controlling one or more functions of an electronic device or appliance.

10. The haptic feedback device of claim 1, further comprising a second actuator coupled to the touch screen to apply a second force to the touch screen.

11. The haptic feedback device of claim 1, wherein at least the first force is output substantially perpendicular to the plane of the touch screen.

12. The haptic feedback device of claim 1, wherein the first actuator is a piezo-electric actuator.

13. The haptic feedback device of claim 1, wherein the first actuator is a voice coil actuator.

14. The haptic feedback device of claim 1, wherein the first actuator includes a solenoid.

15. The haptic feedback device of claim 1, further comprising a touch screen microprocessor separate from the computer device configured to provide control signals to the first actuator.

16. The haptic feedback device of claim 1, wherein the touch screen is disposed in a housing that is separate from the computer.

17. The haptic feedback device of claim 1, further comprising a touch screen microprocessor separate from the computer device and configured to provide control signals to control the at least one actuator.

18. The haptic feedback device of claim 1, wherein at least one actuator outputs a continuous vibration or a pulse tactile sensation on the touch screen.